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Cactus Cladistics Lab Glossary of Terms:

(“*” = Definitions from *Biology* 7th ed. by Campbell & Reece)
 (“[]” = Additions to *Biology*’s definitions for more precise information.)

analogous (*analogy): similarity between two species that is due to convergent evolution rather than descent from a common ancestor with the same trait.

apomorphic: A derived character state.

areoles: A rounded or elongated, often raised or recessed, short shoot of a cactus. Areoles are considered to be homologous to lateral (axillary) buds. Areoles give rise to spines, flowers, long shoots, glochids (in Opuntioideae), and roots.

***CAM plant (CAM= Crassulacean acid metabolism):** A plant that uses crassulacean acid metabolism, an adaptation for photosynthesis in arid conditions, first discovered in the family Crassulaceae. Carbon dioxide entering open stomata during the night is converted into organic acids, which release CO₂ for the Calvin cycle during the day when stomata are closed.

***clade:** A group of species that includes an ancestral species and all its descendants. [A branch of a cladogram; a monophyletic group of taxa sharing a closer common ancestry with one another than with members of any other clade.]

***cladistic methods:** The analysis of how species may be grouped into clades. [A method of classification that groups taxa by their possession of shared, derived (synapomorphic) characters and emphasizes that all named taxa must be monophyletic.]

convergent evolution: The independent evolution of structural or functional similarity in two or more unrelated or distantly related lineages or forms that is not based on genotypic similarity and common ancestry; homoplasy; convergence; convergent adaptation.

cushion plant: a plant that is compact, low-lying, and horizontally spreading.

derived: A new character or character state not present in the ancestor; apomorphic.

ephemeral: lasting for a short time as compared to the length of time that the organ lasts in other plants.

glochids: small barbed spines derived from reduced leaves, a shared derived character (synapomorphy) of the Opuntioideae.

Scanning electron micrograph of an *Opuntia* glochid:



<http://www.biologie.uni-hamburg.de/b-online/e05/r10.htm#01>

***homologous structures/traits:** Structures in different species that are similar because of common ancestry. [(1) structures, traits, or properties having common ancestry but not necessarily retaining similarity of structure, function, or behavior; (2) characters that share an evolutionary transformation from the same ancestral character state.]

***homoplasy/homoplastic:** Similar (analogous) structure or molecular sequence that has evolved independently in two species. [Resemblance due to convergent evolution rather than to common ancestry.]

***ingroup:** In a Cladistic study of evolutionary relationships among taxa of organisms, the group of taxa that is actually being analyzed. [In cladistic analysis, the group of (theoretically) closely related species of interest to a researcher.]

***internode:** A segment of a plant stem between the points (nodes) where leaves are attached.

long shoot: a stem with long internodes. This term is applied only in plants in which internode length is clearly bimodal and both long and short shoots are present. (See short shoot)

mesic: an environment having a balanced supply of moisture or organisms that are adapted to that environment.

***monophyletic:** Pertaining to a grouping of species consisting of an ancestral species and all its descendants; a clade. (See paraphyletic and polyphyletic)

New World: Areas of the world that include North, Central, and South America.

***node:** A point along the stem of a plant at which leaves are attached.

***outgroup:** A species or group of species that is closely related to the group of species being studied [ingroup], but clearly not as closely related as any study-group members are to each other. [Ideally, the outgroup should be the sister group of the ingroup.]

***ovary:** In flowers, the portion of a carpel in which the egg-containing ovules develop. [After fertilization and subsequent maturity the ovary becomes the fruit and ovules become seeds. The **ovary position** may vary in relation to the stamens, petals, and sepals. An ovary is called **superior** if those parts are attached below it, **semi-inferior** if they are attached alongside it, and **inferior** if they are attached above it.]

Ovary Positions labeled diagrams:

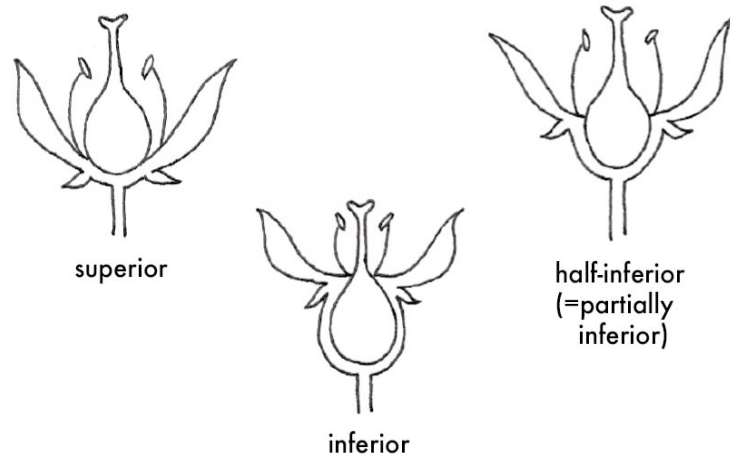


Figure __. Ovary positions.

Parts of a flower:

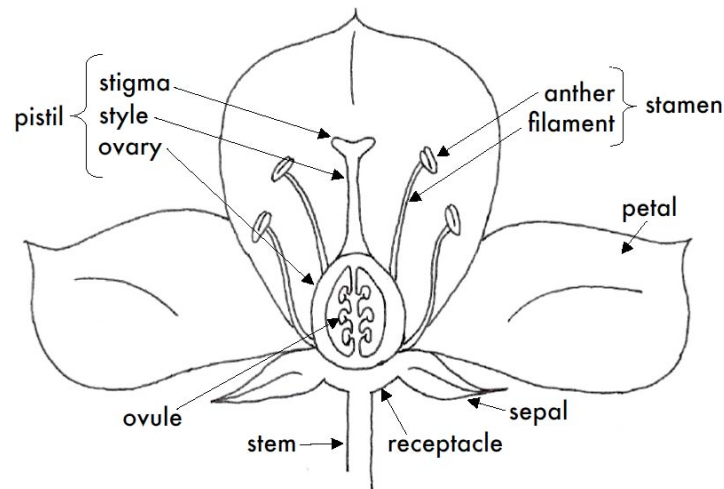


Figure __. Parts of a typical flower.

Cactus flower:

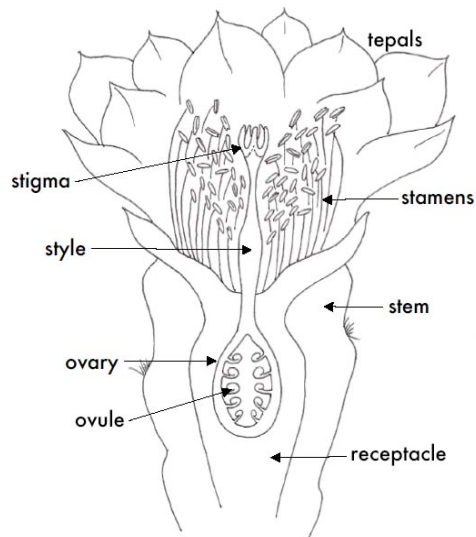


Figure __. Cross-section of *Opuntia* (prickly pear) flower showing the ovary deeply recessed into the stem.

***paraphyletic:** Pertaining to a grouping of species that consists of an ancestral species and some, but not all, of its descendants.

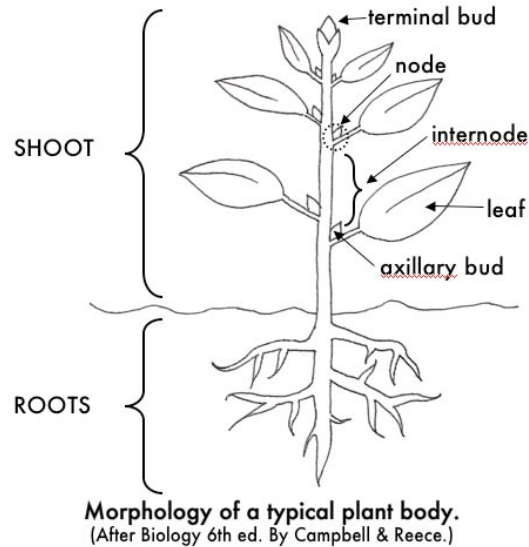
Parsimony: The principle that proposes that we should accept the simplest explanation. In cladistics, this means that the “best” cladogram is the one that proposes the least number of evolutionary changes.

***Pereskia* Model:** A hypothesis that suggests *Pereskia* species represent the “ancestral” condition from which the highly specialized morphology and physiology of typical cacti arose, because *Pereskia* species are believed to possess morphologies of “relictual cacti”.

***phylogeny:** The evolutionary history of a species or group of related species.

***pistil:** A single carpel or a group of fused carpels.

Plant Body (Typical) labeled diagram:



***polyphyletic:** Pertaining to a grouping of species derived from two or more different ancestral forms. A grouping of species that lacks their common ancestor (see Fig. 25.10c, in *Biology* 7th ed., by Campbell & Reece). A polyphyletic group of species is often grouped together based on similar functional traits that are often analogous characters due to convergent evolution (i.e., fast swimmers, Fig. 40.2, in *Biology* 7th ed., by Campbell & Reece).

radiation: (*adaptive radiation): The emergence of numerous species from a common ancestor introduced into an environment that presents a diversity of new opportunities and problems. [The evolutionary diversification of an ancestral taxon into a number of different ecological roles or modes of life (adaptive zones), usually over a relatively short period of time.]

relictual: Refers to having features similar to the deceased ancestor.

***shoot system:** The aerial portion of a plant body, consisting of stems, leaves, and (in angiosperms) flowers.

short shoot: Plants whose stems have short internodes. This term is applied only in plants in which internode length is clearly bimodal and both long and short shoots are present. (See long shoot)

sister group: Sister groups are the two monophyletic groups produced by a single dichotomy; each is the other's nearest relative.

spine: a stiff pointed plant process that is a modified leaf or leaf part.

***stoma (pl. stomata):** A microscopic pore surrounded by guard cells in the epidermis of leaves and stems that allows gas exchange between the environment and the interior of the plant.

succulent plant: A plant having fleshy tissues that store and conserve moisture.

succulent stems: Plant stems that become very fat because of water accumulation. Plants with succulent stems use the water as a reservoir for long dry periods. Many plants with succulent stems also have spines to protect their water-rich stems from herbivory.

***systematics:** The analytical study of the diversity and relationships of organisms, both present-day and extinct. [Also, the classification of living organisms into hierarchical series of groups emphasizing their phylogenetic interrelationships; often used as equivalent to taxonomy.]

synapomorphy: A shared derived character.

***taxon (pl. taxa):** The named taxonomic unit at any given level of classification.

tepals: Used to describe flower petals and sepals that look the same.

***transpiration:** The evaporative loss of water from a plant. [Most transpiration occurs through stomata.]

vestigial (*vestigial organ): A structure of marginal, if any, importance to an organism. Vestigial organs are historical remnants of structures that had important functions in ancestors. [Structures that are degenerate or imperfectly developed; used for structures or functions that have become diminished or reduced during the course of evolution or during growth and development.]

xeric: characterized by, relating to, or requiring only a small amount of moisture.

***xerophyte:** A plant adapted to an arid climate.